General Safety Requirements For Cutting and Welding Operations

Occupational Safety and Health Bureau

Montana Department of Labor and Industry

Prepared for Montana Employers
by the

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GENERAL SAFETY REQUIREMENTS
FOR
CUTTING AND WELDING OPERATIONS

Health, safety, personal protection, and ventilation

First-aid equipment must be available at all times. All injuries must be reported as soon as possible for medical attention. First aid must be rendered until medical attention can be provided.

Where the work permits, the welder should be enclosed in an individual booth painted with a finish of low reflectivity such as zinc oxide (an important factor for absorbing ultraviolet radiations) and lamp black, or must be enclosed with noncombustible screens similarly painted. Booths and screens must permit circulation of air at floor level. Workers or other persons adjacent to the welding areas must be protected from the rays by noncombustible or flameproof screens or shields or must be required to wear appropriate goggles.

Employees exposed to the hazards created by welding, cutting, or brazing operations must be protected by personal protective equipment in accordance with OSHA requirements. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed.

When welding must be performed in a space entirely screened on all sides, the screens must be so arranged that no serious restriction of ventilation exists. It is desirable to have the screens so mounted that they are about 2 feet (0.61 m) above the floor unless the work is performed at so low a level that the screen must be extended nearer to the floor to protect nearby workers from the glare of welding.

Local exhaust or general ventilating systems must be provided and arranged to keep the amount of toxic fumes, gases, or dusts below the maximum allowable concentration as specified in 29 CFR 191 0.1000.

A number of potentially hazardous materials are employed in fluxes, coatings, coverings, and filler metals used in welding and cutting or are released to the atmosphere during welding and cutting. These include but are not limited to- Beryllium, Cadmium, Flourine, Lead, Mercury, and Zinc. The suppliers of welding materials must determine the hazard, if any, associated with the use of their materials in welding, cutting, etc.

All filler metals and fusible granular materials must carry the following notice, as a minimum, on tags, boxes, or other containers:

"CAUTION! Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z49.1 - 1967 Safety in Welding and Cutting published by the American Welding Society."

Brazing (welding) filler metals containing cadmium in significant amounts must carry the following notice on tags, boxes, or other containers-.

"WARNING! CONTAINS CADMIUM - POISONOUS FUMES MAY BE FORMED **ON** HEATING. Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air-supplied respirators. See ANSI Z49.1 - 1967. If chest pain, cough, or fever develops after use call physician immediately."

Brazing and gas welding fluxes containing fluorine compounds must have a cautionary wording to indicate that they contain fluorine compounds. One such cautionary wording recommended by the American Welding Society for brazing and gas welding fluxes reads as follows-.

CAUTION! CONTAINS FLUORIDES. This flux when heated gives off fumes that may irritate eyes, nose and throat.

1. Avoid fumes - use only in well-ventilated spaces.

2. Avoid contact of flux with eyes or skin.

3. Do not take internally

Oxygen cutting, using either a chemical flux or iron powder or gas-shielded arc cutting of stainless steel, must be done using mechanical ventilation adequate to remove the fumes generated.

Degreasing and other cleaning operations involving chlorinated hydrocarbons must be so located that no vapors from these operations will reach or be drawn into the atmosphere surrounding any welding operation. In addition, trichloroethylene and perchlorethylene should be kept out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations.

Ventilation for general welding and cutting

Mechanical ventilation must be provided when welding or cutting is done in a space of less than 1 0,000 cubic feet (284 m(3)) per welder-, in a room having a ceiling height of less than 16 feet (5 m); or in confined spaces or where the welding space contains partitions, balconies, or other structural barriers to the extent that they significantly obstruct cross ventilation.

Ventilation must be provided be at the minimum rate of 2,000 cubic feet (57 m(3)) per minute per welder, except where appropriate local exhaust hoods and booths a, or airline respirators

approved by the U.S. Bureau of Mines for such purposes are provided. Natural ventilation is considered sufficient for welding or cutting operations where the restrictions listed in the preceding paragraph are not present.
Mechanical local exhaust ventilation may be by means of either of the following:

(1) Freely movable hoods intended to be placed by the welder as near as practicable to the work being welded and provided with a rate of air-flow sufficient to maintain a velocity in the direction of the hood of 1 00 linear feet (30 m) per minute in the zone of welding when the hood is at its most remote distance from the point of welding. The rates of ventilation required to accomplish this control velocity using a 3-inch (7.6 cm) wide flanged suction opening are shown in the following table:

Welding Zone	Minimum air flow cubic feet/minute	Duct diameter inches
4 to 6 inches from arc to torch:	150 cfm	3
6 to 8 inches from arc or torch:	275 cfm	3 ½
8 to 10 inches from arc or torch:	425 cfm	4 ½
10 to 12 inches from arc or torch:	600 cfm	5 ½

FOOTNOTE(L) When brazing with cadmium bearing materials or when cutting on such materials increased rates of ventilation may be required.

FOOTNOTE(2) Nearest half-inch duct diameter based on 4,000 feet per minute velocity in pipe.

(2) A fixed enclosure with a top and not less than two sides which surround the welding or cutting operations and with a rate of airflow sufficient to maintain a velocity away from the welder of not less than 1 00 linear feet (30 m) per minute.

Eye protection

Helmets or hand shields must be used during all arc welding or arc cutting operations, excluding submerged arc welding. Helpers or attendants must be provided with proper eye protection.

Goggles or other suitable eye protection must be used during all gas welding or oxygen cuffing operations. Spectacles without side shields, with suitable filter lenses are permitted for use during gas welding operations on light work, for torch brazing or for inspection.

All operators and attendants of resistance welding or resistance brazing equipment must use transparent face shields or goggles, depending on the particular job, to protect their faces or eyes, as required.

Eye protection in the form of suitable goggles must be provided where needed for brazing operations.

The following is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs.

Welding operation	Shade No.
Shielded metal-arc welding – 1/16-,3/32-,	
1/8-,,5/32-inch electrodes	10
Gas-shielded arc welding (nonferrous) –1/16-, 3/32-,	
1/8-, 5/32-inch electrodes	11
Gas-shielded arc welding (ferrous) –1/16-, 3/32-,	
1/8-, 5/32-inch electrodes	12
Shielded metal-arc welding:	
3/16-, 7/32-, ¼-inch electrodes	12
5/16-,3/8-inch electrodes	14
Atomic hydrogen welding	10-14
Carbon arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1 inch to 6 inches	4 or 5
Heavy cutting, 6 inches and over	5 or 6
Gas welding (light) up to 1/8 inch	4 or 5
Gas welding (medium) 1/8 inch to ½ inch	5 or 6
Gas welding (heavy) ½ inch and over	6 or 8

NOTE: In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use filter or lens that absorbs the yellow or sodium line in the visible light of the operation.

Fire prevention and protection

The basic precautions for fire prevention in welding or cutting work are:

Cutting or welding must be permitted only in areas that are or have been made fire safe. When work cannot be moved practically, as in most construction work, the area must be made safe by removing combustibles or protecting combustibles from ignition sources.

If the object to be welded or cut cannot readily be moved, all movable fire hazards in the vicinity must be taken to a safe place.

If the object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, then guards must be used to confine the heat, sparks, and slag, and to protect the immovable fire hazards.

If these requirements cannot be followed then welding and cutting must not be performed.

Wherever there are floor openings or cracks in the flooring that cannot be closed, precautions must be taken so that no readily combustible materials on the floor below will be exposed to sparks which might drop through the floor. The same precautions must be observed with regard to cracks or holes in walls, open doorways and open or broken windows.

Suitable fire extinguishing equipment must be maintained in a state of readiness for instant use. Such equipment may consist of pails of water, buckets of sand, hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed.

Fire watchers are required whenever welding or cutting is performed in locations where other than a minor fire might develop, or any of the following conditions exist:

> Appreciable combustible material, in building construction or contents, closer than 35 feet (1 0. 7 m) to the point of operation.
>
> Appreciable combustibles are more than 35 feet (1 0. 7 m) away but are easily ignited by sparks.
>
> Wall or floor openings within a 35-foot (1 0. 7 m) radius expose combustible material in adjacent areas including concealed spaces 'n walls or floors.
>
> Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation.

Fire watchers must have fire extinguishing equipment readily available and be trained in its use. They must be familiar with facilities for sounding an alarm in the event of a fire. They must watch for fires in all exposed areas, try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm. A fire watch must be maintained for at least a half hour after completion of welding or cutting operations to detect and extinguish possible smoldering fires.

Before cutting or welding is permitted, the area must be inspected by the individual responsible for authorizing cutting and welding operations. He must designate precautions to be followed in granting authorization to proceed preferably in the form of a written permit.

Where combustible materials such as paper clippings, wood shavings, or textile fibers are on the floor, the floor must be swept clean for a radius of 35 feet (1 0. 7 m) Combustible floors

must be kept wet, covered with damp sand, or protected by fire-resistant shields. Where floors have been wet down, personnel operating arc welding or cutting equipment must be protected from possible shock.

Cutting or welding must not be permitted in the following situations-

- In areas not authorized by management.
- In sprinklered buildings while such protection is impaired.
- In the presence of explosive atmospheres (mixtures of flammable gases, vapors, liquids, or dusts with air), or explosive atmospheres that may develop inside uncleaned or improperly prepared tanks or equipment which have previously contained such materials, or that may develop in areas with an accumulation of combustible dusts.
- In areas near the storage of large quantities of exposed, readily ignitable materials such as bulk sulfur, baled paper, or cotton.

Where practicable, all combustibles must be relocated at least 35 feet (1 0.7 m) from the work site. Where relocation is impracticable, combustibles must be protected with flameproofed covers or otherwise shielded with metal or asbestos guards or curtains.

(For elaboration of these basic precautions and delineation of the fire protection and prevention responsibilities of welders and cutters, their supervisors (including outside contractors) and those in management on whose property cutting and welding is to be performed, see, Standard for Fire Prevention in Use of Cutting and Welding Processes, N FPA Standard 51 B, 1 962.)

Confined spaces

When arc welding is to be suspended for any substantial period of time, such as during lunch or overnight, all electrodes must be removed from the holders and the holders carefully located so that accidental contact cannot occur and the machine be disconnected from the power source.

In order to eliminate the possibility of gas escaping through leaks or improperly closed valves, when gas welding or cutting, the torch valves must be closed and the gas supply to the torch positively shut off at some point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch hour or overnight. Where practicable, the torch and hose must also be removed from the confined space.

All welding and cutting operations carried on in confined spaces must be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. This applies not only to the welder but also to helpers and other personnel in the immediate vicinity. All air

replacing that withdrawn must be clean and respirable.

In such circumstances where it is impossible to provide such ventilation, airline respirators or hose masks approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health must be used.

In areas immediately hazardous to life, hose masks with blowers or self-contained breathing equipment must be used. The breathing equipment must be approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health.

Where welding operations are carried on in confined spaces and where welders and helpers are provided with hose masks, hose masks with blowers or self-contained breathing equipment approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health, a worker must be stationed on the outside of such confined spaces to insure the safety of those working within.

Oxygen must never be used for ventilation.

Management responsibilities in cuffing and, welding safety

Management:

must recognize its responsibility for the safe usage of cutting and welding equipment on its property and:

Based on fire potentials of plant facilities, establish areas for cutting and welding, and establish procedures for cuffing and welding, in other areas.

Designate an individual responsible for authorizing cutting and welding operations in areas not specialty designed for such processes.

Insist that cutters or welders and their supervisors are suitably trained in the safe operation of their equipment and the safe use of the process.

Advise all contractors about flammable materials or hazardous conditions of which they may not be aware.

The Supervisor:

Must be responsible for the safe handling of the cutting or welding equipment and the safe use of the cutting or welding process.

Must determine the combustible materials and hazardous areas present or likely to be present in the work location.

Must protect combustibles from ignition by the following,

Have the work moved to a location free from dangerous combustibles.

If the work cannot be moved, have the combustibles moved to a safe distance from the work or have the combustibles properly shielded against ignition.

See that cutting and welding are so scheduled that plant operations that might expose combustibles to ignition are not started during cutting or welding.

Must secure authorization for the cutting or welding operations from the designated management representative.

Must determine that the cutter or welder secures his approval that conditions are safe before going ahead.

Must determine that fire protection and extinguishing equipment are properly located at the site.

Where fire watches are required, he must see that they are available at the site.